

Stories of the future: personal mobility innovation in the United Kingdom

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Original research article

Stories of the future: Personal mobility innovation in the United Kingdom

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ABSTRACT

This paper looks at personal transport futures in the context of greenhouse gas emissions reduction, as portrayed in documents from various stakeholders in the transport sector. It analyses the role of frames and narratives in constructing stories of the future, through the lens of two innovations: electric vehicles (EVs) and car clubs. Most of the documents draw on technological progress to tell stories of a future similar to the present but with EVs or other low-carbon vehicles, while car club focused documents stress broader notions of sustainability. A number of economic, technological and political-related frames are identified, which are used in constructing and justifying these stories. Some frames, such as 'economic growth', are nearly ubiquitous. Narratives support and are sometimes actively supported by the stories, such as 'technology neutrality'. Frames and narratives play a key role in creating stories of the future, and help create and maintain expectations and legitimacy of innovations. Frame analysis helps unpick and challenge unrealistic expectations that might leave us unprepared for the future.

1. Introduction

The future of surface transport is a much debated topic. Specifically, the current modes and volume of personal mobility are considered environmentally unsustainable, primarily because of greenhouse gas emissions of cars. In the UK, as elsewhere, there have been growing concerns about transport implications for climate change, but also for energy security, social exclusion, and public health and wellbeing [1]. Personal surface transport in the UK has for decades been dominated by a system of *automobility* where privately owned cars are seen as a right and a necessity; car-based mobility is linked to economic development; and norms, practices and institutions reinforce the role of cars in society [2,3]. This makes the system resilient and resistant to change, as path dependencies and lock-in make shifting the transport system towards sustainability difficult. However, there are many innovations which could potentially make personal mobility more sustainable, from technical improvements to engines and new fuels, to new models of transport behaviour and car ownership. Creating future visions is considered part of the innovation process: it can raise expectation and lend legitimacy to an innovation, generate support from stakeholders.

This paper reports from a project on future visions of personal mobility in the UK, in the context of sustainability and emissions reduction, and the dominance of the private vehicle. Roughly 25% of UK CO₂ emissions come from transport, nearly 2/3 of which comes from cars and vans [4]. Two relevant innovations were considered in the study: electric vehicles (EVs), which offer technological reduction in

emissions, but potentially keep other parts of automobility in place, and car clubs, which offer cultural and behavioural shifts, including severing the link between car use and ownership. There are other innovations of interest, with autonomous vehicles (driverless cars) receiving attention recently. However, this study focuses on two innovations which are already well-established in the transport system and therefore in policy-relevant literature. A collection of 20 documents looking at the future was analysed; these include forecasts, roadmaps, pathways, and more. We consider each document to be a *future exploration*. The explorations were created by various stakeholders in the UK transport sector, including government, industry, consultancies and transport coalitions. The research focused mostly on EVs, as they feature more prominently in most documents, with car clubs offering a counterpoint useful for examining underlying assumptions in the narratives. Another paper from this study [5] focuses on how aspects of the future were imagined and how the visions served the agendas of their authors. This paper considers how the framing of the innovations plays an important role, with frames acting as building blocks in constructing stories told about the future, and how narratives, which weave together different frames, reflect and strengthen dominant worldviews and agendas. It concludes that analysing the frames underlying the stories helps unpick and challenge unrealistic expectations that might leave us unprepared for the future.

Section 2 offers a theoretical background on the importance of visions in innovation (2.1), and describes the concepts of frames and narratives and their use in this paper (2.2). Section 3 outlines the

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methodology, including selection of documents and coding procedure. Section 4 reviews some of the common frames in the explorations, while Section 5 covers some demonstrative narratives found implicitly or explicitly in the visions. Section 6 offers some conclusions and observations.

1.1. Terminology

Internal combustion engine vehicles (ICEVs) are ‘regular’ vehicles powered by combustion of petrol or diesel. In contrast, *electric vehicles* (EVs) are powered using electrical energy, most commonly stored in plug-in rechargeable batteries. The term EV sometimes also includes *plug-in hybrids*, which have both an electric motor and an internal combustion engine. *Ultra-low-emission vehicles* (ULEVs) refer to any motor vehicle with very low emissions, including EVs (when powered by low carbon electricity), biofuel and hydrogen powered vehicles, and other technologies. Finally, *car clubs* are a form of shared mobility where members pre-book cars for short periods, often paying by the hour. Cars are typically picked up and dropped off at the same on-street location.

2. Background – stories of the future

2.1. Visions and expectations

Stories about the future are often articulated as *visions*. Visions can be powerful tools in public discourse and policymaking, because those that become widely accepted can shape expectations about the future, and therefore motivate actions in the present towards such a future [6,7]. Such visions can be considered ‘shared imaginaries’, which have been defined as “collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology” ([8], p. 6). In the innovation context, successful vision creation can generate more support from a greater range of stakeholders (e.g., [9–11]), for example when rapid technological change is required, “technology promoters have much to gain by having ‘the public’ on-side rather than resistant to innovation” ([12], p. 931). More broadly, in order to be successful and effective, visions must attract credibility through realistic strategies and tactics, achieving the right balance between utopia and realism, and also have the potential to be open to new entrants [7].

This paper takes the position that imagined futures are always normative, as they inevitably make assumptions about behaviour, economics, technological development, and more. Assumptions about innovations could include imagining the nature and behaviour of adopters and users, which could significantly shape innovation trajectories in envisioned futures. The visions literature can therefore be useful even for future explorations which do not intentionally pursue a political or other agenda.

A variety of research points to the importance of creating *expectations* about the future of innovations, partly through the use of visions. Expectations can motivate and stimulate action on technological innovation among engineers, designers and managers, as well as among sponsors, investors and politicians [13,14]. It has been further argued that expectations and visions are not separate from the technological innovation process, but a formative element of it (e.g., [14,15]).

Ruef and Markard [16] argue that actors sometimes strategically inflate expectations of new technologies to attract resources and attention. Once expectations are shared, they effectively act as requirements that cannot be ignored by other innovating actors, which can lead to a period of *hype*, during which media attention and expectations peak. A ‘herd effect’ is also possible as technological ‘solutions’ become more and less fashionable [17]. Periods of hype are inevitably followed by a decline in expectations and attention, potentially leading to disappointment. While details of this ‘hype cycle’ model have been

criticised, the concept of hype and disappointment is well established (e.g., [18]).

For any innovation to be widely taken up, it must gain *legitimacy*, that is, it must be accepted by a (perceived) consensus of a social group as matching their norms, values, practices and procedures [19]. Sources of legitimacy are varied, and can include narratives, discourses, verbal accounts, and traditional and social media [20]. Legitimacy can be crucial early in an ‘innovation journey’ for securing investments, ventures and policy support for new technologies, while later in the journey, legitimacy can maintain public and political support [21]. Maintaining positive expectations after a hype and disillusionment cycle can be crucial to keep legitimacy intact [16]. The next section turns to frames and narratives, which underpin the stories that help create and maintain expectations and legitimacy.

2.2. Frames and narratives

This paper focuses on some of the building blocks of stories of the future – frames and narratives – and how they make these stories influential. Frames can be described as conceptual models that help us make sense of the world, or “basic cognitive structures which guide the perception and representation of reality” [22]. This approach follows the cognitive sciences, which suggest we think in terms of unconscious structures – *frames* (or *schemata*), with even our everyday thinking using metaphorical concepts that are deeply entrenched and culturally reinforced [23]. Our knowledge makes use of frames, and our neural circuits mean repetition of frames makes them more ‘hardwired’ in our brains, connected to emotions and ideologies more than reason [24].

Frames can structure “which parts of reality become noticed” [22]. Lakoff [24] suggests that facts must make sense in terms of the system of frames of the person hearing them, or they will likely be ignored. In this way frames might limit our understanding, e.g., we might have the ‘wrong’ environmental frame to understand the ‘real crisis’ [24]. Public discourse can be thought of as which frames are being activated, and therefore strengthened. In sum, frames “are principles of selection, emphasis and presentation composed of little tacit theories about what exists, what happens, and what matters” ([25], p. 6).

A more constructionist approach suggests that people such as journalists cannot tell stories effectively without preconceived notions [26]. Van Gorp reviews how journalists need myths, archetypes and narratives to cover news events; culturally constructed and embedded frames are part of the journalist’s toolkit, as their symbolic meaning evokes other stories the audience is familiar with [27,26]. Culturally embedded frames are ‘universally understood codes’ [26]. In this approach, the storyteller *chooses* their frames, and in fact, Van Gorp states that ‘individuals can mediate the persuasive power of frames by *using* them’ (2010, p. 89). The documents studied here are reports and reviews, but nonetheless the authors do have an audience in mind.

This paper draws on both approaches. Frames found in the documents studied could be Lakoff’s cognitive tools which shape how we see the world, often unconsciously. However, they could also be Van Gorp’s rhetorical devices, with authors choosing to tell a story whilst invoking certain culturally understood codes that match their agendas. These do not contradict each other, as the authors, in Lakoff’s terms, seek to activate, and thereby strengthen, their preferred frames.

Frames are not fixed, but can change over time, and be replaced in the long term as new frames are born and gain popularity. They can become ‘reified’ in various institutions and cultural practices; they will then not disappear until the institutions and practices change [24]. König [22] suggests two criteria for viability of frames, that is, how likely they are to become culturally resonant: *narrative fidelity*, i.e., how congruent the frame fits with the personal experiences of its audience; and *empirical credibility*, i.e., how well the frame fits with real world events (which might be derived from mainstream discourses). In the context of new vehicle technologies, Ruef and Markard [16] see frames as “overarching expectations which place the technology in the context

Table 1

Final sample of documents with visions of future transport in the UK.

exploration (and reference)	year	produced by (& for)	focus
Developing Car Clubs in Scotland [37]	2010	Richard Armitage for Transform Scotland Trust	car clubs
Car-sharing in London – Vision 2020 [38]	2014	Frost & Sullivan for Zipcar	
A new approach to predict the market... carsharing systems: Case study of London [74]	2014	Le Vine et al. (academic publication)	
A Car Club Strategy for London [39]	2015	(members of the) Car Club Coalition	
Scope for the Transport Sector to Switch to EVs and PHVs [40]	2008	Arup and Cenex for BERR and DfT	EVs
Market outlook to 2022 for BEVs and PHEVs [41]	2009	AEA for CCC	
How to Avoid an Electric Shock: Electric cars: from hype to reality [42]	2009	Transport and Environment	
Market Delivery of Ultra-Low Carbon Vehicles in the UK [43]	2011	Ecolane for RAC Foundation	Low emission vehicles
Leading the Charge: Can Britain develop a global advantage in ULEVs? [44]	2013	Institute for Public Policy Research (IPPR)	
Pathways to Future Vehicles: A 2020 Strategy [45]	2002	EST (TransportAction) for UK Government	road transport
Passenger car market transformation model [46]	2007	Element Energy and Ricardo Ltd for EST	
The King Review of low carbon cars: Part I [47]	2007	Julia King for UK Government	
The King Review of low carbon cars: Part II [48]	2008	Julia King for UK Government	
Powering Ahead: The future of low-carbon cars and fuels [49]	2013	Ricardo-AEA Ltd for RAC Foundation & UKPIA	
Fourth Carbon Budget: Reducing emissions through the 2020s [50]	2010	CCC for UK Government	UK economy
The Carbon Plan: Delivering our low carbon future [51]	2011	DECC for Parliament	
Fourth Carbon Budget Review: technical report [52]	2013	CCC for UK Government	
Meeting Carbon Budgets – 2014 progress report to parliament [4]	2014	CCC report to Parliament	
Future Energy Scenarios: UK gas and electricity transmission [53]	2015	National Grid	gas & electricity
Intelligent Infrastructure Futures: The Scenarios – Towards 2055 [54]	2006	Foresight Programme	UK futures

of generic societal problems or visions” (p. 324). Such expectations can direct technological innovation and create hype, as our stories affect reality. However, if they fail to deliver, the post-hype disappointment will lead to a loss of empirical credibility as the frame loses viability.

In this study, frames were chosen for their salience in telling stories of the future, the assumptions or agendas they highlighted, or the difference between stories that resulted from choice of frame. Frames were chosen from economic, technological and other contexts, and included things like *consumer choice*, *technology as progress*, and *(un)sustainable transport*. The methodology and chosen frames are detailed in Section 3.2.

Beyond individual frames, this paper considers how frame combinations are used to tell stories of the future, and what part these stories play in policy related discourses. A *narrative* can be described as a script structure which shows development in phases from emergence to problem to resolution, and could be constructed from a repertoire of frames [26,28]. Narratives are a mechanism by which frames are circulated and (re)produced, making them a rhetorical tool in construction of group identity (e.g., [29]) or building powerful stories about the future. The focus in this paper is on how the narratives told make use of different frames, how they serve different agendas, and how they might alter expectations or lend legitimacy to different innovations or other ideas.

Two broad narratives are apparent from the choice of study: The first is the emergence of climate change and the problem of surface transport CO₂ emissions, which will be resolved through improvement of standard vehicles (ICEVs) and the introduction of electric vehicles (or other technologies). This mainstream story is not surprising, given the role of automobility in our culture. The second defines the emergence of a broader sustainability problem, in which cars are implicated, and there is a shift to integrated transport and away from privately owned vehicles. This includes ‘car club narratives’, where clubs grow to fulfil their presumed potential, thereby maintaining access to mobility. The reduction in personally owned vehicles saves people money (benefitting local economies), reduces CO₂ emissions, and also benefits local communities through reduced congestion and air pollution. Other, more specific narratives will also be highlighted, as will interpretations of narratives as ‘hero stories’ [30], in considering how frames and narratives found in the collected future explorations of personal transport tell stories of the future.

3. Methodology

3.1. Selecting documents

In this project, documents about the future of transport and mobility in the UK were analysed. The documents include reports and reviews prepared by, and on behalf of, a range of stakeholders in the UK transport sector, including government, industry, consultancies and transport coalitions. Over 40 relevant documents were found through web searches, journal articles, transport reports, and suggestions from colleagues. Documents were selected for several criteria:

- They consider EVs’ or car clubs’ role in the future of personal mobility in the UK.
- They contain projections for the medium term future, i.e., 2020s–2050s, a period long enough for a systemic shift, or ‘socio-technical transition’, in the transport sector [31,32];
- They were published in 2002–2015; this is a period during which hype over EVs increased [32] to the point that some believe the automotive industry has chosen EVs as the ‘winner’ among low-carbon technologies [33], while car clubs grew from a few thousand members to nearly 200,000 in the UK, mostly in London [34,35], and there was a general increase in public discourse about low carbon transport [36].
- They were suited to in-depth textual analysis.

The study ultimately focused on the 20 documents listed in Table 1. While not exhaustive, these come from a variety of different bodies, and were chosen to cover a wide range of political, technological, economic and behavioural assumptions and perspectives without too much repetition.

Only a few of the documents focus exclusively on car clubs or EVs in the UK. However, the documents that focus on low emission vehicles, road transport or the UK economy as a whole all discuss EVs (or low-carbon vehicles more generally) as the main route to transport emissions reduction, while only a few mention car clubs, usually grouped with local action or behaviour change as complementary action. The main focus of the research was therefore on EVs, with car clubs offering a counterpoint that helped highlight agendas and assumptions.

3.2. Frame analysis

Coding for frames in the documents was a mixed process of

searching for pre-defined frames and identifying frames by recurring themes in the texts. The goal was to create a list of frames that matched salient themes in the explorations, helped identify agendas or pre-valient assumptions, or differentiated between narratives.

When choosing or defining frames, it is important to find the appropriate level of abstraction. Van Gorp [26] suggests frames should be applicable to other issues beyond the specific topic. König [55] suggests three well established ‘master frames’: the ethno-nationalist frame, which considers an ontology based on religion, culture etc.; the liberal-individualist frame, which considers individual freedom and equality; and the harmony with nature frame, which attributes intrinsic value to nature. Alongside them, König offers three ‘generic frames’: conflict, human interest and economic consequences. These are all too general for this study. In technology focused studies, Dijk [56] uses more specific attribute framing in a study comparing perceptions of diesel, hybrid-electric and battery-electric car engines. These include technological attributes such as capacity, noise and efficiency, and other parameters such as social connotation and tax benefit. These are not sufficiently abstract, and deviate from the definition of frames used here. Ruef and Markard’s [16] work on stationary fuel cells shows how frames refer to the role of the technology in society, and offers a level of specificity and abstraction appropriate to this study.

König [55,22] suggests there is a tendency in frames analyses to produce new, unique sets of frames, where almost anything can pass as a frame, meaning creating new frames is better avoided. This paper follows König’s advice and makes use of Ruef and Markard’s [16] work in order to reduce creating new frames. Ruef and Markard list four contexts: society, environment, policy and economy. The emphases in this paper lead to a partially matching list of contexts: economics, technology, policy, transport and environment. Further, several of Ruef and Markard’s frames were used with slight variation as the basis of the frames in this study: ‘technological progress’ (this paper: *technology as progress*), ‘market potential’ (*markets*), and ‘nations’ (*the greater good*), while others were less relevant due to difference in focus, such as ‘hydrogen economy’ and ‘decentralisation’. Where new frames were defined, they were limited to those which represent common themes in the texts, were relevant to transport and discourses of the future, and were useful for analysis.

Van Gorp [26] advises using frames that are mutually exclusive to improve reliability of analysis. However, this study found that using overlapping frames offered a more nuanced analysis, and notes that Ruef and Markard [16] use their listed frames in combination with each other. It is acknowledged that the choice of frames is inevitably arbitrary and subjective to some extent [26]. Ultimately, frames were chosen that either contrast different narratives or highlight salient perspectives in the documents. The list of frames in their contexts, along with an indication of the narratives in which they are used, is in Table 2.

Finally, in order to define identified frames more rigorously, a thematic coding method based on Boyatzis [57] was used, as demonstrated for the identified frame of *technological breakthroughs*, see Fig. 1.

4. Identified frames

There are a large variety of frames in the documents, with economic and technological the most prominent. This section shows how each identified frame is used.

4.1. Economic frames

Economic frames are prevalent in the explorations, with personal transport seen as tightly coupled with the economy. These frames are mostly rooted in free market liberalism, and are uncritical of it, e.g., assuming economic growth is good and (free) markets mechanisms find optimal solutions.

One of the most common frames is *economic growth*, often used to

Table 2

Frames identified and defined in the explorations and their use in the two general narratives and the technology neutrality narrative.

context	frame	EV narrative	car club narrative	technology neutrality
economic	economic growth	yes	some	yes
	markets	yes	no	yes
	consumer choice	yes	yes	yes
technological	technology as progress	yes	no	yes
	technological breakthrough	some	no	yes
	the greater good	some	yes	no
political	responsibility	some	some	yes
transport and environment	continued	yes	no	yes
	automobility (un)sustainable transport	no	yes	no

justify or support an innovation by predictions or assumptions that it will deliver economic growth, new jobs, or other tangible economic benefits. This frame might be used to highlight the challenges of continuing economic growth while reducing emissions, as the (former) Department for Energy and Climate Change suggests in a report to Parliament:

By 2050 the transport system will need to emit significantly less carbon than today, while continuing to play its vital role in enabling economic growth.

It can also be used to promise that low-carbon vehicles offer economic opportunities, as this report from the independent Energy Saving Trust (EST):

Establish the UK as a base for the engineering and manufacturing of low carbon vehicle technologies which could support the creation of new job opportunities.

While the framing of car clubs as providing economic benefits is less common, car club focused visions arguably follow a similar pattern, with innovation leading to economic growth. However, as car clubs are less established than technological innovations in transport, more justification is needed, as demonstrated in this consultancy firm report on car clubs:

[T]he typical London round-trip car-sharing member that disposes/defers car ownership saves £3,000 per year... This cost saving releases more disposable income that can be used more productively in the local London economy.

Another common frame can be called *markets*, a framing that assumes market activity will find the ‘best’ solution or alternative among several (technological) options. It follows that creating markets is a vital step, as expressed by the Government commissioned ‘King Review’ of low-carbon cars (Part 2):

... bringing existing low emission technologies from “the shelf to the showroom” as quickly as possible” and “ensuring a market for these low emission vehicles”.

Further, markets must be maintained through avoiding uncertainty and reassuring consumers, as a report from the thinktank Institute for Public Policy Research highlights:

This creates uncertainty for the ULEV market, as potential consumers need to know that their purchase is contributing to the decarbonisation of the economy.

Finally, *consumer choice* is a frame which presents choice as an inviolable right, tied to notions of (individual) freedom; however, many

1. **label:** technological breakthroughs
2. **definition:** This theme suggests current technologies are insufficient or insufficiently developed for the predicted or desired vision of the future, and that the gap is non-trivial.
3. **description of indicators:** This frame is sometimes used to stress uncertainty or cast doubt about the future of a given (technological) innovation to become widespread and mainstream; it could be used to support one technology over another. It is also sometimes used to stress great potential and great challenges ahead.
4. **qualifications or exclusions:** This frame is not about science fiction, nor about easily achievable incremental improvements in technology. It applies specifically to plausible but uncertain futures, highlighting the non-trivial advances that assumptions about the future might make.
5. **examples:**

An examples of casting doubt:

'[D]espite decades of battery development... Outside niche markets, the future of the electric car does not appear optimistic... Struggles with the development of dedicated battery cars, have led car manufacturers to divert their efforts...' (EST 2002, p.18)

An example of challenge and potential:

'In the longer term, possibly by 2050, almost complete decarbonisation of road transport is possible. This will require breakthroughs in battery and/or hydrogen technology and a zero-carbon power source for these vehicles.' (King 2007, p.70)

Fig. 1. Coding method example for the frame *technological breakthroughs*, based on Boyatzis [57].

explorations effectively limit consumer choice to choice of vehicle purchased. This frame is often used in modelling, where consumer choice is a proxy for behaviour, and used to calculate future projections or results of proposed interventions. In these models consumers are often framed as rational economic actors, as in this modelling exercise from the EST:

It is then assumed that each consumer makes an assessment of the various attributes of the vehicles, to define an overall score (or utility) for each vehicle. The consumer chooses the vehicle with the maximum utility.

Choice is sometimes invoked as a reason for intervention, e.g., enabling new technologies to reach markets so consumers can choose between them, as in the King Review quote above. On the other hand, it is sometimes invoked as a reason for lack of intervention. For example, regarding car clubs, the King Review argues for 'promotion', but not market creation:

Promotion of car clubs by central government could increase awareness and enable people to make informed decisions over whether car clubs could be appropriate for them personally.

This suggests an underlying agenda of techno-optimism, where technological innovations are considered central to reducing emissions, but other shifts to more sustainable modes of behaviour are marginal. The seeming frustration at lack of EV uptake (see 5.2) strengthens the idea that low carbon vehicles are seen as the 'correct' choice for consumers.

4.2. Technological frames

Technology as progress is a frame in which technological development, and especially innovation, is seen as synonymous with (beneficial) progress. Ruef and Markard [16] have a similar frame 'technological progress', which also suggests a 'better future world', as progress is assumed to be purely positive.

One of the uses of this frame is the assumption that challenges can and will be solved with technological solutions. This focus on technological solutions marginalises other policy options, such as behaviour change or cultural shift, as irrelevant, unnecessary or extremely difficult. For example, a modelling exercise commissioned by the former

Department for Business, Enterprise and Regulatory Reform and the Department for Transport [40] projects emission futures as EVs and hybrids penetrate the market, but the projections do not change car demand, mileage or journey profiles, despite discussing the geography of EV spread (from urban centres outwards). Similarly, the Energy Saving Trust [46] model the uptake of different low-carbon vehicles under different policy scenarios; despite a wide range of parameters, consumer behaviour is modelled only in choice of car purchase. While these explorations acknowledge the limitations of their models, the framing of emissions reduction through market transformation to low-carbon vehicles, with no social or cultural changes, ignores the co-evolution of norms and practices with technology [58].

Technology as progress reassures us that even if one technology fails, another will succeed. For example, the Committee on Climate Change [50] analyses EVs' potential, but then suggests that if EVs prove unsuccessful through 2030, hydrogen vehicles will penetrate the market more. These ideas support – and are supported by – a narrow definition of sustainable transport as reduction in carbon emissions (see 4.4).

A different frame could be called *technological breakthrough*. This is a frame which casts doubt on the ability of technology to deliver, until some – usually unlikely – breakthrough is achieved, i.e., current technologies are insufficient or insufficiently developed for the predicted or desired vision of the future. This frame applies specifically to plausible but uncertain futures, highlighting the non-trivial advances that assumptions about the future might make.

This might seem incongruous with the general techno-optimism of many visions, but this frame is applied to *specific* technologies, used to cast doubt on their ability to deliver, but not the ability of technology as a whole to succeed. Nonetheless, there is a certain irony in invoking notions of technological failure, or the endless wait for a breakthrough, in techno-optimistic explorations.

This frame is sometimes used to stress uncertainty or cast doubt about the future of a given (technological) innovation to become widespread and mainstream. Doubt about EVs' potential is present in some of the earlier of the explorations in this study, e.g.:

[D]espite decades of battery development... Outside niche markets, the future of the electric car does not appear optimistic... Struggles with the development of dedicated battery cars, have led car manufacturers to

divert their efforts...

Some explorations suggest shorter term emission targets can be fully met through improvements to internal combustion engine vehicles (ICEVs), using the uncertainty around ultra-low emissions vehicles (ULEVs) to strengthen the message. In the longer term, ULEVs might be inevitable, and the same framing of technological breakthrough is sometimes used to stress great potential and great challenges ahead, as the King Review (Part 1) demonstrates:

In the longer term, possibly by 2050, almost complete decarbonisation of road transport is possible. This will require breakthroughs in battery and/or hydrogen technology and a zero-carbon power source for these vehicles.

Bucking the trend of technological optimism is the Foresight¹ work [54], in which drivers and trends of transport futures were developed in workshops with “Experts from the research community, business and the public sector” (p. 1). Scenarios were based on two key uncertainties: whether low-environment-impact transport systems would be developed and whether people would accept intelligent infrastructure, which could respond ‘autonomously and intelligently’. This outlier contradicts assumptions made in most of the explorations: that technological progress will necessarily prevail, and that people will accept it. These stories dare present technological failure and even dystopian futures, in sharp contrast to all other explorations.

A technological narrative implicitly drawn on but not discussed is the *linear model of technological innovation and diffusion*. This model suggests that innovation follows a linear route, beginning with basic research, followed by applied research and development, and ending with production and diffusion (e.g., [59]). This narrative is a powerful rhetorical tool, connecting several themes together. For example, in the studied explorations, development of EVs (or other low-carbon cars) is a preliminary requirement (*technological breakthrough*) before marketisation (*markets*), with barriers to uptake, or demand more broadly, addressed last (*consumer choice*). The linear model has been critiqued for, among other things, drawing a strong distinction between the social and the technical, and thereby lacking the socio-technical context in which technological innovation happens [60], but is nonetheless widely used. While it is not universally understood, and too specific for this paper’s definition of a frame, in some contexts it might act as one, as “[i]t is a thought figure that simplifies and affords administrators and agencies a sense of orientation when it comes to thinking about allocation of funding to R & D” ([59], p. 659).

4.3. Political frames

Two related political frames are identified. The first is *the greater good*, which frames action as something that ‘should’ be done. It is marked by an appeal to national or local pride, such as London’s transport reputation:

London’s transportation network is regularly benchmarked globally, having consistently invested in and promoted sustainable mobility initiatives that have achieved modal shift away from the private car to sustainable travel, public transport in particular.

It can also be a call of duty or a call for leadership, as when the King Review tells us that:

The UK can and should lead by example....

Ruef and Markard [16] have a similar frame ‘nations’, which focuses on the opportunity for a nation to stay competitive.

Beyond this general call for action, there is a more specific frame of

responsibility, which allocates roles to actors from different sectors (e.g., politicians, local officials, car manufacturers, funding bodies), makes specific policy recommendations, or simply calls for actors to ‘do their part’. This frame appears most commonly in reports for the government, such as the EST and the King Review:

[P]olicy recommendations aimed at ensuring that government, industry, the research community and consumers all contribute to reducing carbon emissions from cars...

4.4. Transport and sustainability frames

The majority of the explorations frame transport as *continued automobility*, seeing the future very much as the present in terms of mobility dominated by privately-owned cars, with high transport demand. Explorations which use this frame analyse the future in terms of the changes in vehicle technology or fuel, with projections of future emissions calculated from uptake of EVs or other low-carbon vehicles and improvements to ICEVs. Other changes, such as modal shifts or reduced travel, are considered complementary or marginal in effect. Sustainability is portrayed as predominantly about reducing greenhouse gas emissions, allowing high demand to continue, as long as cars can be made ‘low-carbon’.

A competing frame might be called *(un)sustainable transport*, framing current transport as unsustainable *beyond* the need for emissions reduction – not surprisingly used in car club related explorations. In this frame, the current transport regime and trends are framed as problematic, due to congestion, air pollution, equity and accessibility, future population growth and more. This implies that reducing car numbers and usage is desirable or even necessary, as this report from Transform Scotland² puts it:

The essential prerequisites for expanding car club membership in Scotland ... [include] addressing the need for changes in attitudes in our “car culture”.

However, the explorations that use this frame stop short of calling for a car free culture, as the London based Car Club Coalition shows:

Car clubs will play an important role in reducing the need to have a car because they offer an alternative to conventional car use models and can reduce habitual car use while still enabling access to a car for essential journeys.

This section showed how individual frames reflect worldviews, assumptions and agendas, and how these come into play in building stories of the future visions. The next section considers putting frames together in those stories.

5. Narratives

This section looks beyond individual frames to consider how narratives weave frames together into powerful discourse. The aim is to show how they are used by different actors, and to analyse how different frames are used in constructing them. Three examples of narratives are highlighted, which might be called the good, the bad and the neutral.

5.1. The good: narratives of success

A recurrent theme in the explorations is the story of success. The scenarios and projections almost always detail the ‘good news’, i.e., how targets and challenges can be met, or how innovations will succeed. The narratives are often excused as heuristic tools and not

¹ Foresight projects work with government departments, experts and academics to identify where new or emerging science can help make policies that are more resilient to the future.

² Transform Scotland researches and campaigns for socially and environmentally sustainable transport.

predictions, but nonetheless there is a noticeable lack of scenarios that detail missing emission reduction targets, and how such situations might be dealt with (which also have heuristic value).

Reducing emissions is often framed as a difficult challenge, which can be met through strong action. For example, the Committee on Climate Change reports to Parliament that:

The fact that electric (and other ultra-low emission) vehicles play a potentially major role in moving to a low-carbon economy therefore poses a challenge ... However, there are a number of promising developments which provide confidence that this challenge can be addressed.

These narratives invoke political frames such as *the greater good* and *responsibility*, but as always, economics are important, with *consumer choice* and *economic growth* frames used, for example:

The key challenge in transport is decarbonising travel in a way that is both cost effective and acceptable to consumers.

One of the challenges these stories face is the electricity grid itself, and its carbon emissions, as in this consultancy report on the future of low-carbon cars and fuels:

And then there is their future greenhouse gas reduction potential, which relies largely on decarbonisation of the grid. Although this is strongly implied by the Climate Change Act 2008, it cannot be accepted as a given ...

While these narratives do not promise success, in not discussing the possibility of failure, they seem to suggest that a shift away from fossil fuel vehicles is inevitably on the way, despite presenting it as a challenging task. This could be explained by the need to raise expectations and gain legitimacy and support for innovations in low-carbon vehicle technology, or more broadly to create shared visions of the future (imaginaries) in which these vehicles succeed both in reducing emissions from surface transport and in maintaining the automobility system.

The success stories could be classified as *hero stories* in which society is saved by new technologies; the technologies themselves are the hero [30]. Janda and Topouzi draw on Vogler's [61] modernised map of a hero's journey (inspired in turn by Campbell [62]). An early stage in the journey is 'crossing the threshold', when the hero commits to the challenge, leaving the 'ordinary world' for a 'special world' with unfamiliar rules. Janda and Topouzi interpret this as the 'imaginary world' of technical potential. The success narratives, which draw on technological promise and pay less attention to social context and behaviour, match this interpretation well as 'there is no need for people to change because the technology will make the necessary changes for us' ([30], p. 519).

A notable exception to the success stories comes from the National Grid [53] exploration, which focuses on electricity use throughout the UK economy (including EVs). It provides four scenarios according to higher or lower future prosperity and higher or lower social ambition to decarbonise the economy. Only one scenario, where society is environmentally engaged with higher prosperity, leads to meeting the UK's emission reduction targets on time. The IPPR report, which uses the National Grid's scenarios, is more candid than most about the difficulties in meeting the targets:

Representatives from the automotive industry expressed frustration at the rate of progress of the energy industry in preparing the UK for a transition towards ultra-low emission vehicles... [The energy industry] expressed frustration that ULEVs are not designed with the UK electricity network in mind.

These setback stories could be seen as *learning stories* [30]: these take place in the messy real world, with protagonists who are normal people rising to a challenge. In the energy context, the learning story happens in the gap between technical potential and what is actually achieved [30].

Car club explorations also use narratives of success. First, in an optimistic portrayal that car clubs will grow and prosper, even without policy support, and more so with support. There appears to be some hype in the predictions, as one exploration [39] looks at scenarios for 500,000 members in Greater London by 2020, and a 'more ambitious' 1 million users by 2025. In Scotland [37], projections for 2014/15 of up to 13,000 members without policy support proved overly optimistic, with actual numbers around 7600 [35]. Second, these narratives build on the (un)sustainable transport frame in emphasising how car club success could deliver sustainability – a future with fewer cars but high access to multi-modal mobility, with diverse social, environmental and economic benefits.

Again, this optimism could be explained by the need to create expectations and gain support for car clubs (as an innovation). The marginal role car clubs play in most of the explorations, despite having more users than there are EVs on the roads, suggests they have less legitimacy as a 'proper' form of transport that can play a part in a shift to sustainability.

5.2. The bad: frustration of failure

An implicit theme emerging in some of the more recent explorations is addressing low sales numbers of EVs, with narratives suggesting this is a 'demand side problem', and attempting to understand the lack of consumer uptake. An exploration from consultancy Ecolane [43] expresses this most clearly, claiming that car manufacturers are rising to the challenge of delivering low-carbon cars for the future, and that consumer demand must now be addressed. This logic limits behaviour to choice of car purchased, and is in line with the linear diffusion model (see 4.2), portraying the technological innovation process as separate from the socio-cultural process of diffusion, with the need to tackle 'barriers' to uptake – both financial and non-financial.

Some attempts to understand low uptake use the economic frames of market solutions and consumer choice, suggesting failure to purchase EVs is due to their high upfront cost and consumers having 'high discount rates'. There seems to be – in explorations written by or for government – frustration that consumers are *not* behaving as rational actors: they fail to recognise future savings from EVs' low running costs. This behaviour is described as 'sub-optimal' [48] or 'myopic' [50], as purchasing an EV would seem to be 'in their own interests' [47]. On the other hand, several explorations highlight the fact that consumer purchase of vehicles does not follow the rational economic model, as they value certain vehicle features even if these do not give significant savings [41,49]. In addition, brand loyalty and symbolism such as status and identity play a role in car choice [43,4].

More recent explorations problematise users in another way. While the range of EVs (distance before recharging) is portrayed as a barrier throughout, only a few recent (2013–2015) explorations use the phrase 'range anxiety', portraying this squarely as a user issue rather than a technical challenge. This dichotomy is also found in how users are framed in a recent Norwegian study on stakeholders' imagining of EV users [63]: on the one hand, users were portrayed as rational actors concerned with cost, but on the other, range anxiety was believed to be a major concern – and was seen as an irrational fear, a psychological barrier that would disappear with experience of EV use. This dual framing of the public is discussed by Barnett et al. [64], who contrast public concerns that could be addressed, which were seen as understandable or rational, such as cost and performance, with situations where the public was seen as 'blinkered' or having 'misconceptions', of which range anxiety could be an example.

The inconsistent framing of people indicates clinging to certain frames or narratives that have lost *empirical credibility* [22] – a sign of not accepting facts that do not match their system of frames [24]. There also appears to be an element of the automotive industry shifting risk and responsibility by portraying the lack of uptake of low emission vehicles as a problem for the state or civil society, whilst still portraying

behaviour narrowly as choice of vehicle. The EV hype from 2005 onwards [32] might have met disillusionment due to low sales in following years, so shifting perception to present the technologies and industry as successful might help maintain the positive frames and legitimacy needed [16,21] for ongoing political and stakeholder support.

Going back to the *hero's journey* [62,61]: in the final stages of the story, the hero returns to the 'ordinary world' and faces last minute dangers. The frustration at lack of demand could be interpreted as a final test after the demons were thought to be conquered. The problematisation of users after manufacturers rose to the challenge could even be seen as the 'purification' of the hero: the technology is flawless and must not be tainted by the users. Alternatively, the frustration could be seen as part of a *learning story* [30], as the ideal technologies encounter the real world.

5.3. The neutral: technology

Several documents refer to the importance of government, or government policy, being 'technology neutral'. *Technology neutrality* is a narrative in which policies and regulations should not choose winners among technologies offering essentially similar services or solutions, as the markets can – and will – choose the most successful options. In our context, this means the best options of the fuel and engine technologies available to deliver a reduction in greenhouse gas emissions will win out. Several explorations written by and for government, or by consultancies, suggest the automotive industry supports technology neutrality [45,48,47,40,49], e.g.:

There is a strong sentiment in the vehicle manufacturing community that interventions by Government should be technology neutral.

Some government written documents, in turn, support this call [50,51]:

We cannot say for sure which technologies will emerge as the most effective means of decarbonising car travel, so it is essential that the Government takes a technology neutral approach, allowing us to achieve emissions reductions in the most cost effective way.

The conscious, active reinforcement and reassurance of this narrative are what distinguish it from a frame: frames do not require justification and explanation. Unpacking the narrative suggests it frames sustainable transport narrowly as reducing emissions, and relies on frames including: *technology as progress, continued automobility, markets, and consumer choice*. It also links to the hesitation of the state to pick winners in a free market paradigm, perhaps invoking bad experiences of the state picking early winners in the past. This can be seen, for example, in calls to gradually reduce tailpipe emission targets or regulations (e.g., [4]), allowing for ICEV improvements alongside uptake of EVs and other ULEVs, rather than show explicit support for EVs. Hesitation to back EVs has been observed in Sweden as well [65].

While technology neutrality could be seen as simple prudence in the face of unknown development, it is important to recognise that it is a policy that favours incumbent firms and established technologies which do not require public support. It could be seen as a delaying tactic protecting ICEVs in the short term. In addition, the dialogue between policymakers and industry reinforces the current transport regime [66]. Overall, there is much to suggest that this narrative is a political tool serving agendas of incumbent powerful actors.

6. Discussion and conclusions

This paper reviews frames and narratives used in explorations of personal transport futures in the UK, considering perspectives from frame analysis, visions and expectations, and stories of the future. This section offers some summarising thoughts and conclusions.

There are, not surprisingly, differences between the stories told by incumbents in what might be considered a 'central narrative' of the

future, and alternative stories, such as car club narratives. The central narrative portrays the future as an unbroken continuation of the past and present, including continued car culture and high transport demand, relying on technological progress to meet a narrowly defined sustainability agenda. This story relies on several frames as building blocks – economic growth, technological progress, consumer choice, and automobility, and invokes political and technological narratives such as the 'linear model' and 'technology neutrality'. It creates narratives of success which tend to reinforce incumbent power whilst promising sustainability in the form of lower emissions. By contrast, car club focused visions discuss integrated transport yielding local and national benefits, with greater change to how (and how much) we travel, building on frames of economic growth and consumer choice, but questioning frames of automobility and narrow definitions of sustainability, and hardly relying on technological progress.

Systems of frames underlie political ideologies, worldviews and moral codes [23,24]. Lakoff's work suggests that in (US) politics, conservatives make better use than liberals of a unified, self-reinforcing worldview, through long-term framing of issues, connecting the rhetorical and the cognitive [23,67]. This paper shows how different frames are used together in stories of the future, relying on and reinforcing each other. Most important is the belief of strong links between technology, mobility and the market economy, best expressed in the King Review:

Technological progress has been fundamental to furthering the universal objectives of growth and mobility. It has also enabled a major, global industry to prosper in its own right.

This, then, is the reinforcement of an entire worldview through the repeated framing of issues. This 'dominant worldview', in which mobility and technology are intimately linked to economy, can more easily accommodate privately owned electric vehicles than car clubs, which require institutional and behavioural shifts. Put in terms of the *hero story*, a clever technology can save the day without need for behaviour change [30].

The frustration found in some explorations at low uptake of EVs, contrary to the 'rational economic actor' model, matches Lakoff's [24] description of framing limiting our understanding. Some documents going as far as trying to fit reality into their system of frames, by suggesting consumers need education about whole life cost of vehicles [40]. However, the dominant worldview is not homogenous: there are also explorations that acknowledge that a more nuanced understanding of behaviour is needed; it is worth considering how to strengthen the currency of those stories.

Electric vehicles now appear to have a promising future in the UK: sales have risen sharply in recent years to over 28,000 in 2015, making up 1.1% of sales [68], and they feature prominently in the government's recent Industrial Strategy Green Paper [69]. However, this has not been a smooth road. This hero's journey arguably began with the realisation of the threat of emissions reduction:

[P]olicy makers have come to realise the difficulties in reducing greenhouse gas emissions (GHG) from the transport sector, particularly given the strong linkages between transport consumption and economic growth.

However, the transition to EVs is far from trivial, in terms of both infrastructure and consequential changes beyond the technological shift. EVs are a threat to some incumbent actors, through changes in supply chains, the repair industry and fuel supply, and more generally the risk of great change which not all incumbent manufacturers will survive. In order to become acceptable to the dominant worldview, EVs are framed as a straightforward substitution for internal combustion engine vehicles (ICEVs), leaving automobility virtually unchanged. This assumes behaviour to be fixed and independent from technological artefacts, whereas in reality, norms and practices co-evolve with technology [58].

A German study [70] suggests there are discrepancies between

visions of the future based on sustainable electric mobility and strategies rooted in the current regime: portraying EVs as a 'techno-fix' could jeopardise 'deeper' sustainability transitions to lower car dependency, and moreover, this innovation cannot simply replace ICEVs without significant change, perhaps even redefining the role of the car in society. So, while building on accepted frames has gained EV narratives legitimacy by building on expectations of continued automobility and lowered emissions, these stories have played down both the potential for greater change from electrified transportation, and the inevitably disruptive transformation process. This suggests that even if current efforts to electrify transport are successful, they might leave us unprepared for the future. This can be seen as a precautionary tale of not appreciating the inevitable disruption and unpredictable socio-cultural changes from technological innovations.

It is worth considering what is missing from the explorations analysed. One omission from both the main narratives is the possibility of a post-car society. Indeed, even 'peak car' was not discussed in any of the documents. The car club narrative suggests severing the link between ownership and car use, retaining functionality of car journeys where necessary. This goes against current trends, where the functionality of car use as a means of transport is arguably declining, especially in car-saturated urban environments in the developed world, although its cultural value is still great [71]. However, others suggest the image of the car has been reduced from an 'icon of modernity' to a more utilitarian perspective as 'an ordinary piece of household equipment' [72]. The omission of this entire debate attests to the strength of the continued automobility framing. While beyond the scope of this study, autonomous vehicles (driverless cars) could affect automobility through shifts in car ownership and image. However, the technology in itself does not guarantee sustainability in terms of CO₂ emissions or access to mobility.

Examples of broader stories missing from most explorations can be found in the future scenarios of the Foresight work [54]. The potential for technological failure, resulting in greatly reduced mobility and transport no longer seen as a right, matches the *horror story*, the 'tale no one wants to tell' ([30], p. 520). It is worth considering whether avoiding stories of failure leaves us overoptimistic about the challenges ahead.

There are limits to this type of study, such as the inherent subjectivity of frame analysis. Moreover, each document analysed was written with various audiences in mind (such as policymakers, industry, or the investment community), and it is possible to read too much into them. Nonetheless, these are influential stories which shape public discourse about the future. If we do not question these stories, and how they were made, they might leave us overoptimistic and underprepared for the future. In Lakoff's terms, if we think in terms of the 'wrong frames' we cannot fully understand the environmental crisis, much less act on it. It is worth considering how to "[plan] the frames that are needed in the long run" ([24], p. 79), or in other words, how we plan a 'cognitive policy' for the future. Some suggestions can be found in Janda and Topouzi's [30] *caring story*, which aims to create greater engagement with the system around us and establish new social norms. Here, this could imply actors supporting deeper change advocating to policymakers and the public why a more sustainable transport system is worth the effort. This engagement with more actors, especially non-incumbent actors, can broaden the 'we' who plan the future and include more stories in public discourse. Alternative stories can take the form of social innovation, creating new norms and institutions that help maximise the benefits of 'green' technological innovations through recognising their social aspects [73]. Social innovations for sustainability often sit outside mainstream socio-economic narratives, and find it hard to gain support and legitimacy. Nonetheless, they could offer much needed alternative frames and narratives for planning for the future.

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